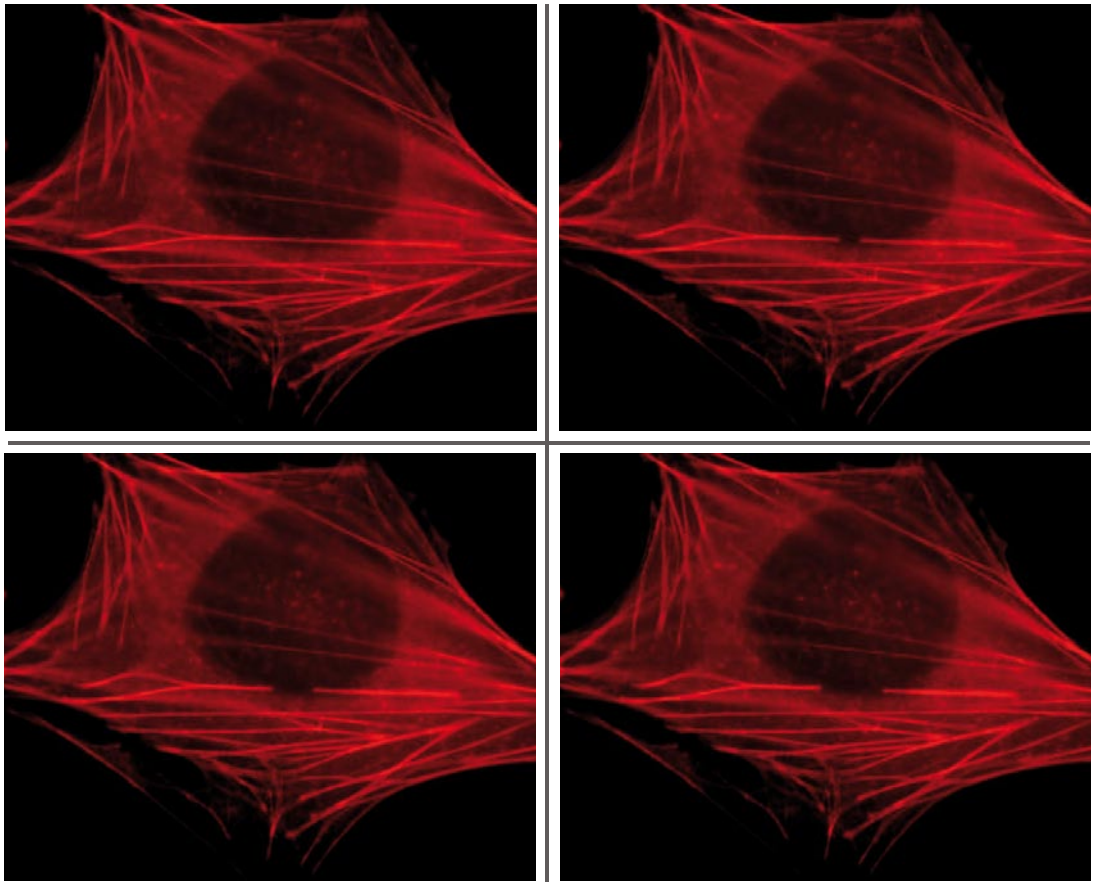
LLS ROWIAK LaserLabSolutions

CellSurgeon



High Precision Nanosurgery
High Resolution Multiphoton Imaging

CellSurgeon is a laser dissection and multiphoton imaging system which enables precise, contact-free 3D-nanodissection of cells and subcellular structures. CellSurgeon can be used in living cells for studies of cell dynamics. Selective manipulation of cell organelles makes it possible to assess an impact on specific cellular processes. Furthermore, CellSurgeon is suitable for optoporation, a novel highly effective method of cell transfection. Experiments of accurate cutting in living small organisms with subsequent time-lapse recordings in 3D can easily be performed by means of CellSurgeon.

CellSurgeon - Laser Surgery with Nanometer Precision

Multiphoton Imaging

CellSurgeon uses a femtosecond laser not only for manipulation but also for imaging. Whenever multiphoton imaging becomes a method of choice, CellSurgeon comes into consideration with its high penetration depth and high 3D-resolution. Visualization of numerous samples is often possible even without employing fluorescent markers, which may interfere with the processes in the cell.

3D-Dissection

For many applications though, mere visualization is sometimes not sufficient, active manipulation of cellular processes is often beneficial. The laser light of CellSurgeon is only absorbed at high intensity. This occurs only at the tight focus and allows you to operate in a very precise manner. Moreover, due to high penetration depth of near-infrared laser, CellSurgeon is the ideal tool to perform imaging plus manipulation in thick samples with only minimal phototoxic effects.

Designed with You in Mind

CellSurgeon can be configured to your specification. The modular concept of CellSurgeon makes it adaptable to various microscopes and imaging procedures. The easy-to-operate software of CellSurgeon includes modules for 3D-dissection, confocal image acquisition, and basic image processing. One-stop provider LLS ROWIAK LaserLabSolutions offers customized solutions for different applications.

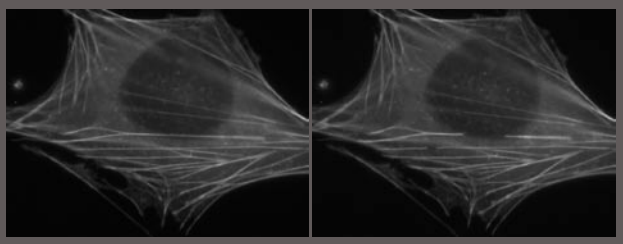
Manipulate and Image - From Organelles To

Manipulate and Observe in 3D

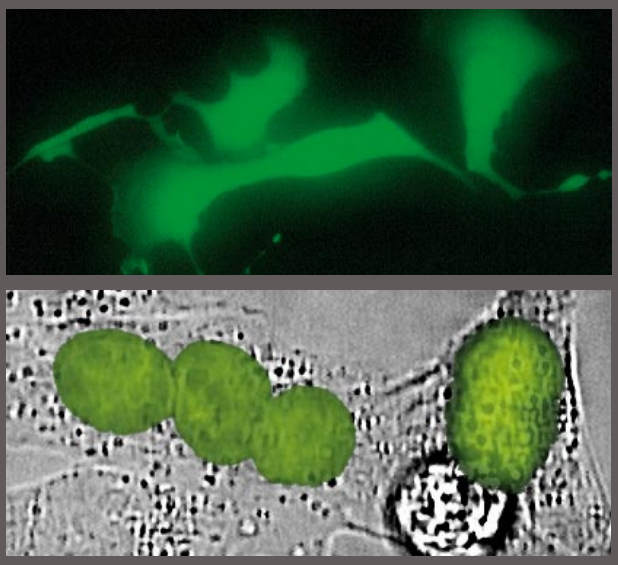
Laser manipulation and subsequent observation of thick and sometimes unstained biological specimens in 3D are often desired features. CellSurgeon allows both; to perform very precise dissection and to observe large and complex 3D biological specimens over time.

True optical sectioning and virtually no photo damage outside the focal plane are intrinsic properties of the system which is of great benefit for long-term imaging. CellSurgeon has proven itself as useful for the investigation of multi-cell structures such as small model organisms and spheroids.

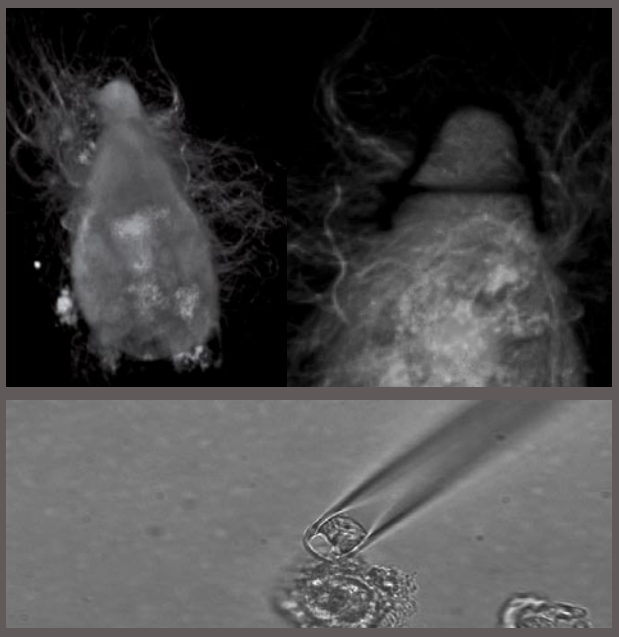
CellSurgeon takes advantage of modern fs-laser technology and is adaptable to essentially every specimen manipulation approach.



Precise single cell manipulation | Dissection of actin filaments in living cell without damaging the cell membrane



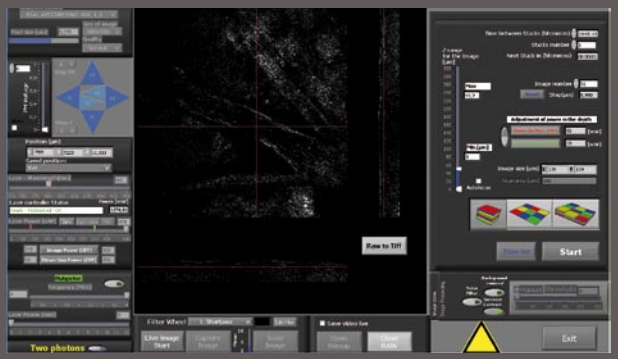
Optoporation* | Granulosa cells (top) transfected with eGFP and canine mammary adenoma cells (bottom) transfected with eGFP-HMGA2 by optical perforation



Dissection | Imaging | Extraction | 3D-reconstruction of z-stack of native protist before and after dissection | The anterior part of protist extracted by means of microcapillary

Optoporation*

Optoporation is a new method for cell transfection. Ultrashort laser pulses can be used to temporarily perforate cell membrane. By focusing the laser beam for a few milliseconds close to the cell membrane, transient pores can be gently created. Optoporation is an excellent technique with high efficiency rates and a wide range of use. Optical perforation is extremely mild to cells and considerably decreases the risk of cell damage. Optoporation is the method of choice to transfect stem cells and primary cells.

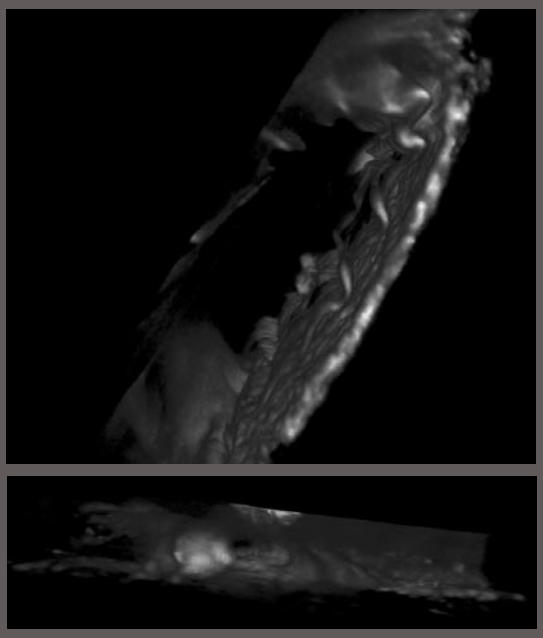


* CellSurgeon module for transfection of molecules into living cells is available only with an additional module for frequency doubling of the laser frequency. Please contact our product manager for further information.

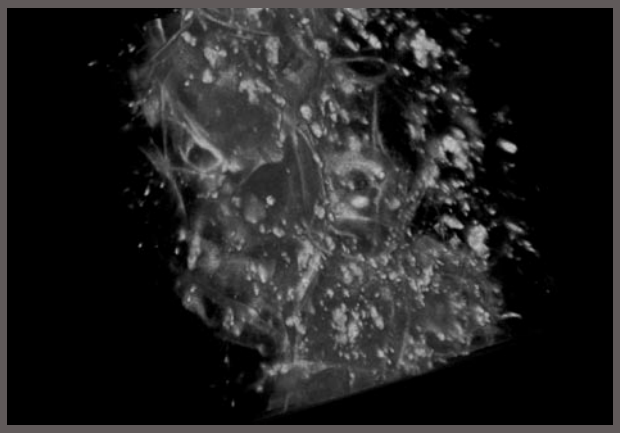
Cells To Tissue To Whole Organisms

3D-Dissection | Nanosurgery

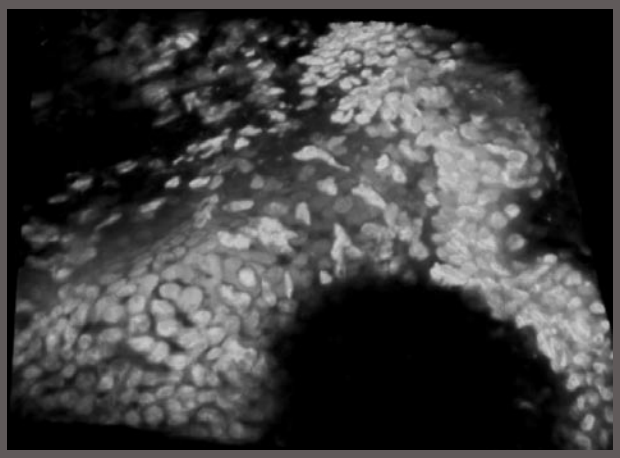
CellSurgeon can be used *in vivo* to perform high spatial resolution imaging of cellular and subcellular structures. But, in parallel to its applications in imaging, multiphoton absorption can be used as a tool for the selective manipulation of subcellular processes in living cells. CellSurgeon can easily be applied to disrupt a single cell without causing any visible damage to the surrounding structures. Furthermore, the precision of CellSurgeon allows dissecting subcellular structures but preserving the structural integrity of the cell. The same method can be used to affect blood flow in small blood vessels by means of photo-disruption of blood vessel walls. CellSurgeon represents a useful tool to generate different models of neurodegenerative or vascular diseases.



Nanosurgery | Marker-free imaging
Top: 3D-reconstruction of 100 µm z-stack of blood vessel
Bottom: Laser manipulation on the inside of blood vessel



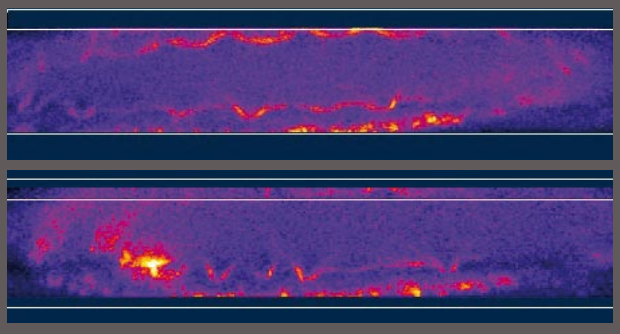
Plant tissue | 3D-reconstruction of 150 µm z-stack of unstained banana leaf



Human tissue | 3D-reconstruction of 120 µm z-stack of DAPI stained human skin

One Solution - 3D Imaging and Dissection

- Precise 3D-dissection
- Multiphoton Imaging
- No sample preparation needed
- Operations in native samples
- Dissection of subcellular structures
- Cutting in living cells or whole small organisms
- High penetration depth
- Marker-free imaging
- Retrofitting of various microscopes is possible



Marker-free imaging | Manipulation | Laser manipulation on the inside of the blood vessel | xz-view

Advantages at a Glance

Feature	Benefit
Dissection	■ Precise 3D-cutting ■ Cutting in native samples ■ Cutting in living cells or whole organisms
Imaging	■ Multiphoton imaging ■ High penetration depth ■ Marker-free imaging
Laser movement by optics	■ Wide range of objectives can be used ■ Use of high NA objectives results in higher cutting precision
User defined settings for laser cutting	■ Live cutting ■ Short set-up time ■ Easy and exact selection of every structure of interest ■ Draw on screen function
Fully motorized cutting module	■ Easy to use ■ Reproducible set-up ■ Increased throughput
Simultaneous 3D-cutting and multiphoton observation	■ Allows selection and documentation in multiphoton mode of structures to be cut ■ Cut and observe in 3D ■ Time-lapse recordings
Versatile and easy to use imaging & cutting software	■ Short training times ■ Multi user friendly ■ Online monitoring
Integrated design	■ Optimal performance ■ One point of contact
Worldwide service and support	■ Fast service and support ■ Remote access software maintenance ■ Maintenance-free laser
Active application support	■ Support on applications development

Technical Specifications

Imaging and Dissection

Laser	High end NIR fs-laser; single wavelength or tunable
Scanner	Two independent scan mirrors
Scan Resolution	700 x 700 down to 300 x 100
Scanning Speed	Max. resolution: 700 x 700 (1,43 f/s) Max. speed: 300 x 100 (10 f/s)
Controllers	Control and configure all motorized components of the system: microscope, scanning module, z-drive, scanning stage, and all accessory units
Workstation	High end PC with high resolving display

Microscope

Stand	Inverted or upright fluorescence microscope stands with three documentation ports; motorized, semi-motorized, or non-motorized
Z-Drive	Piezo objective z-drive (e. g. range max. 320 µm; min. 10 nm)
XY-Stage	Motorized scanning stage with Mosaicking and Mark & Find
Camera	High end digital fluorescence camera; color or b/w
Anti-vibration table	A wide range of optical tables with passive or active vibration isolation and different footprints can be offered

Software

Acquisition	Frame scan; z-stack; time series (xyzt); selection of ROIs; zoom; mosaicking; time-lapse imaging
Dissection	Dissection with different wavelengths; predefined shapes and freehand drawing for 2D and 3D precise dissection; adjustable parameters: laser power, cutting speed, and cutting direction; cut and observe in 3D; live cutting mode; automated processing
Image Archiving	Data depth: 8-bit and 16-bit; Recording formats: RAW, TIF, BMP, AVI, etc.

Optional Components

Micromanipulators & Injectors	Customized solutions for handling of dissected material
Pulse Picker & Controller	Flexible adjustment of laser pulse repetition rate for extremly sensitive cutting studies
Incubation	For long-term observations: Incubator, CO_2 Controller, Temperature Controller
Resonant scan mirrors	For higher scanning speed
Piezo z-drive insert for scanning stage	Fast and easy z-stacking with different objectives
Objectives, Filters & Illumination	For customized solutions

LLS ROWIAK LaserLabSolutions GmbH, Garbsener Landstraße 10, D-30419 Hannover, Germany

Fon: +49 511 277 2976, Fax: +49 511 277 2959, info@lls-rowiak.de, www.lls-rowiak.com